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ONTARIO

Department of Education

Courses of Study

Grade IX

GENERAL SCIENCE

AND

AGRICULTURAL SCIENCE



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COURSES OF STUDY

FOR

Grade IX (Form I Lower School and Fifth Classes)

IN

Collegiate Institutes, High, Vocational and Continuation
Schools and Public and Separate Schools

GENERAL SCIENCE

Objectives:

- (a) to arouse, encourage and utilize curiosity in natural objects and phenomena, in order to develop an understanding of the elementary facts of nature;
- (b) to cultivate discriminating observation, and the ability to carry observation to a logical conclusion;
- (c) to cultivate precise and orderly expression;
- (d) to develop an appreciation of nature;
- (e) to help towards rational and healthy living.

The realization of these objectives demands active participation by the student. It is suggested that this may be achieved by the adoption of the problem method in which experimental work is undertaken as a means of solving a specific problem which has emerged from class discussion.

The experiment itself should be co-operative. Whenever possible the class should have a part in the assembling and use of the apparatus. From the results of experiments a general conclusion should be deduced and its application developed.

The subject matter of the syllabus has been arranged so as to adhere as far as possible to the natural division into biology on the one hand and the closely related sciences of physics and chemistry on the other. Indeed the Ontario climate practically forces such an arrangement on the teacher, even if he were inclined to break through the boundaries between the special sciences. It is recognized, however, that the details of content given below can be arranged in as many ways as there are teachers.

Some may wish to make greater use of the "unit" or "topical" plan than is suggested in the syllabus, feeling that such a method follows the growing interests of the pupils. The topics lend themselves to such a development.

A time allotment is given for each topic merely to indicate the "depth" of treatment intended; but in this matter also the last word must be with the teacher.

OUTLINE OF THE COURSE

Autumn and Early Winter

The relationship of plants to man. (One period.)	A preliminary discussion which will serve to arouse the pupils' interest in botany.
The living plant. (One period.)	Observation of the plant in its natural environment should precede class-room study. Variation in habit and the conditions (light and water) in which the plant grows should be noted.
The shoot and the root. (One period.)	The arrangement of leaves with relation to light; origin of flowers and branches from buds in the axils of leaves; general functions of flower, leaf, stem and root.
The parts of a flower and their functions. (Six periods.)	<p>The shape and arrangement of the parts of two simple flowers, one with separate petals (e.g., buttercup, mustard), one with united petals (e.g., toad-flax, petunia), and of a composite flower (e.g., dandelion <i>or</i> chicory, daisy <i>or</i> cosmos).</p> <p>A hand lens and a needle should be used in examining the stamens, pollen grains, pistil and ovules. (The use of scientific terms in reference to the relationship of parts is not expected).</p>
Pollination. (Four periods.)	<p>Insect pollination and wind pollination; grouping of flowers (inflorescence); floral structure, nectar, abundance of pollen and colour and odour.</p> <p>Examination of the bee to discover adaptations for the collection of pollen and nectar. Simple explanation of fertilization.</p>
Fruit and seed. (Six periods.)	<p>A study of the bean fruit to show the parts, their origin and their relationship to other parts of the plant and to the propagation of the plant.</p> <p>A study of simple fleshy fruits such as the tomato, plum and apple. Adaptations of plants for fruit and seed dispersal.</p>
Weeds. (Two periods.)	Recognition of at least ten common weeds mentioned in the Weed Control Act; sight identification of these should be acquired by field trips or study of specimens collected by the pupils.

Winter

Preliminary discussion of relation of water to plant and animal life. (Two periods.)	<p>Widespread distribution of water.</p> <p>Experiment to show water in plant tissue and in animal tissue (perspiration).</p> <p>Recall water as necessary to plant and animal life (thirst).</p> <p>Recall water as a habitat for plants and animals.</p> <p>Brief discussion of water conservation.</p>
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<p>Water in various states. (Four periods.)</p>	<p>Recall solids, liquids, gases.</p> <p>Recall freezing of water, melting of ice and snow.</p> <p>Observation of snow crystals or other crystals grown by the class as a home assignment.</p> <p>Experiment to show steam from boiling water and condensation on a colder surface.</p> <p>Experiment to show evaporation of water.</p> <p>Formation of dew.</p> <p>Recall frosting of window and appearance of hoar (white) frost to illustrate sublimation.</p> <p>Experiment to show sublimation with benzoic acid.</p>
<p>Importance of water as a solid. (One period.)</p>	<p>Value of snow as a protecting cover for plants and as a means of water storage in nature.</p> <p>Experiment to show expansion of water on freezing, as a home assignment; application to floating of ice and to disintegration of rocks and formation of soil.</p>
<p>Importance of water as a gas. (Two periods.)</p>	<p>Experiment to show presence of water vapour in the atmosphere.</p> <p>Experiment to show great expansion of water on vaporization: reference to the steam engine.</p>
<p>Water as a solvent. (Three periods.)</p>	<p>Distilled and ordinary water; an experimental illustration of the separation of water and dissolved solids by distillation.</p> <p>Solution: experimental illustration of the relative solubility of solids; saturated solutions.</p> <p>The dissolving of air in water and its significance to marine life.</p>
<p>Hard and soft water. (One period.)</p>	<p>The cause of hardness in water.</p> <p>An experimental illustration of the behaviour of hard water with soap.</p>
<p>Thermometers. (Three periods.)</p>	<p>Recall thermal expansion of matter in each of its three states.</p> <p>Experiment to show thermal expansion of liquids.</p> <p>Thermal expansion of liquids as a means of measuring change in temperature.</p> <p>Use of freezing point and boiling point of water as fixed points in establishing a thermometric scale.</p> <p>Compare Fahrenheit and Centigrade scales by reading temperatures in both scales.</p> <p>Compare alcohol and mercury thermometers.</p> <p>Clinical thermometers.</p>

Practice in measurement with metric units. (Four periods.)	<p>Experimental measurement of the area of a rectangular card and of the volume of a rectangular solid.</p> <p>Experimental measurement of the volume of a liquid.</p> <p>Measurement of the mass of a solid by use of a balance.</p> <p>Care of balance.</p>
Density. (Two periods.)	<p>Meaning.</p> <p>Density of the solid used above.</p> <p>Experimental determination of density of water.</p> <p>Importance in nature of maximum density of water.</p> <p>Experimental demonstration of density of mercury.</p>
Municipal water supply. (Three periods.)	<p>How water is brought to the home from its source.</p> <p>An elementary study of the supply, purification and use of water in an urban municipality.</p> <p>Rapid sand filtration:</p> <ol style="list-style-type: none"> (a) Clarification: the effect upon the grains of sand in the bed of adding aluminium sulphate (filter alum). An experimental illustration of the clarification of a clay suspension: the explanation not to involve chemical formulae. (b) Detention of bacteria: recall past reference to harmful bacteria. (c) Chlorination: an explanation of its purpose: not to involve chemical formulae.
Pressure in liquids. (Two periods.)	<p>Experiment to show that water exerts pressure.</p> <p>Experiment to show that the pressure varies with the depth.</p> <p>Experiment to show that the pressure is equal in all directions.</p> <p>Recognition that the weight of a body is a force and that the pressure is due to weight.</p>
The composition of water. (One period.)	<p>The analysis of water by electrolysis to show that it is composed of two gases identified as oxygen and hydrogen.</p>
The composition of air. (Four periods.)	<p>An experimental illustration of the rusting of iron in damp air; the properties and identity of the fraction of air removed and the fraction remaining.</p> <p>Experimental illustration that atmospheric oxygen is necessary for combustion.</p> <p>Experimental illustration of the production of carbon dioxide by:</p>

- (a) combustion of carbon in air,
- (b) respiration.

Demonstration of such properties of carbon dioxide as density, and effect upon a flame.

Importance of air.
(One period.)

The atmosphere.

Air in soil.

Air in water.

The resistance of air to moving bodies.

Air pressure.
(Three periods.)

Experiments to show that air occupies space and that air has weight.

Experiment to show that air exerts pressure.

Applications: self-filling fountain pen; common water-pump; siphon.

Measurement of
atmospheric pressure.
(Three periods.)

Construction of the mercury barometer.

Variation from day to day and from place to place.

The height of a water barometer.

Observation of the aneroid barometer with practice in making readings.

Its use to measure altitude shown by taking readings at different levels.

Compression and
expansion of gases.
(Two periods.)

Experimental demonstration.

Elementary discussion of the relationship of volume and pressure.

Compression of air in the bicycle or automobile tire, air-pump, air-gun, air tools, sand-blast.

Convection in liquids.
(Two periods.)

Recall thermal expansion.

Experiment to show convection currents in water.

Hot-water heating system.

Convection in gases.
(Three periods.)

Demonstration to show convection in air.

Hot-air heating system.

Air movement in a heated room.

Importance of ventilation.

Draught in chimney.

Air movement in refrigerator.

Effects of water in motion.
(One period.)

Rain-wash.
River erosion.
Wave erosion.
Deposition of sediment.

Effects of air in motion.
(Two periods.)

Sailing ships, windmills.
Soil drifting.
Sand dunes.
Rainfall and wind.

The work of the Meteorological Service.
(Three periods.)

Isobars.
Relation of winds to isobars.
Weather maps.
High and low pressure areas with their winds and weather.

Spring and Early Summer

Structure and function of the leaf.
(Nine periods.)

Examination of leaf epidermis, including stomata.
Examination of a cross-section of a leaf to show arrangement of the cells and cell structure.
Demonstration of iodine test for starch.
Experiment to show that starch is made in green leaves in the light and disappears in the dark.
Demonstration of the presence of starch in seeds and tubers, etc.
The use of an aquatic green plant to show the exhalation of oxygen in bright light; the need for carbon dioxide in the process, e.g., comparison of effect with (a) boiled water, (b) boiled water with carbon dioxide added.
Experiment to show transpiration in green plants.

The structure and function of the stem.
(Four periods.)

Examination of a cross-section of oak or other tree trunk to discover: pith, heartwood, sapwood, rays, cambium, outer and inner bark.
Examination of green twig to discover increase in thickness due to activity of cambium and in length due to primary growth.
Demonstration of the rise of water in stems.

Absorption by roots. (Five periods.)	Demonstration of the presence of mineral salts in solution in soil water.
	Observation of the development of root hairs in germinating seeds.
	Demonstration of diffusion of a gas in air and of a dissolved salt in water.
	Simple experiments illustrating the absorption of water with salts in solution through membranes and the significance of this in absorption by roots.
Plant propagation, practical application. (Five periods.)	Means of controlling transpiration in the transplanting of seedlings, shrubs, trees.
	Vegetative reproduction as shown in the growing of strawberry, potato, raspberry, geranium (from slips), etc.
	Pruning of trees; removal of buds and its effect on the growth of the plant.
	Grafting and budding in trees and shrubs.

REFERENCE BOOKS

Elements of Physics	The Copp Clark Co. Ltd.
Chemistry for High Schools	W. J. Gage & Co.
Chemistry Manual	W. J. Gage & Co.
Everyday Problems in Science	W. J. Gage & Co.
Science in Daily Life	Longmans Green & Co.
A Book of General Science	The Macmillan Co. Ltd.
The World of Science	The Ryerson Press
General Science, An Introductory Study of Our Environment (in preparation).	J. M. Dent & Sons, Ltd.

AGRICULTURAL SCIENCE

Objectives:

- (1) To develop an understanding and appreciation of the materials and natural phenomena in the pupils' environment.
- (2) To develop a scientific interest in the problems and activities of rural life.
- (3) To cultivate the pupils' powers of discriminating observation, critical thinking, accurate expression and relating cause and effect.
- (4) To correlate the activities of school work with those of the farm and community.

The method of instruction should provide definite pupil activity in the examining of materials, performing experiments and in outdoor practical work. The project method should have a definite place in the teaching. Every pupil must complete a home project on a suitable topic approved by the teacher as a part of the work of Grades IX and X. This project should be selected in Grade IX.

Well supervised note-book work plays an important part in the training. The note-book should contain a neat and accurate record of the pupil's work, illustrated by suitable diagrams or pictures. These records should be a clear expression of the impressions gained from investigations and discussions.

OUTLINE OF THE COURSE

Autumn and Early Winter

The relationship of plants of man. (One period.)	A preliminary discussion which will serve to arouse the pupils' interest in plants and their relation to Agriculture.
Gardening and weed study. (Two periods.)	Autumn care of the garden; recognition of at least ten weeds mentioned in the Weed Control Act.
The living plant. (One period.)	Observation of the plant in its natural environment should precede class-room study. Variation in habit and the conditions (light and water) under which the plant grows should be noted.
The shoot and the root. (One period.)	The arrangement of leaves with relation to light; origin of flowers and branches from buds in the axils of leaves; general functions of flower, leaf, stem and root.
The parts of a flower and their functions. (Six periods.)	<p>The shape and arrangement of the parts of two simple flowers, one with separate petals (e.g., buttercup, mustard), one with united petals (e.g., toadflax, petunia), and of a composite flower (e.g., dandelion <i>or</i> chicory, daisy <i>or</i> cosmos).</p> <p>A hand lens and a needle should be used in examining the stamens, pollen grains, pistil and ovules.</p> <p>(The use of scientific terms in reference to the relationship of parts is not expected.)</p>

Pollination. (Four periods.)	<p>Insect pollination and wind pollination; grouping of flowers (inflorescence); floral structure, nectar, abundance of pollen, colour and odour.</p> <p>Examination of the bee to discover adaptations for the collection of pollen and nectar.</p> <p>Simple explanation of fertilization.</p>
Fruit and seed. (Six periods.)	<p>A study of the bean fruit to show the parts, their origin, their relationship to other parts of the plant and to the propagation of the plant.</p> <p>A study of simple fleshy fruits such as the tomato, plum and apple.</p> <p>Adaption of plant for fruit and seed dispersal.</p>
Composition, use and care of milk. (Seven periods.)	<p>Composition of whole milk; milk as a complete food; examination of a drop of milk under the compound microscope to observe the fat globules; testing whole milk with the Babcock tester; value of this test in keeping individual cow records and as a basis of payment for milk; care of milk on the farm.</p>

Winter and Early Spring

Preliminary discussion of relation of water to plant and animal life. (Two periods.)	<p>Widespread distribution of water.</p> <p>Experiment to show water in plant tissue and in animal tissue (perspiration).</p> <p>Recall water as necessary to plant and animal life (thirst).</p> <p>Recall water as a habitat for plants and animals.</p> <p>Brief discussion of water conservation.</p>
Water in various states. (Four periods.)	<p>Recall solids, liquids, gases.</p> <p>Recall freezing of water, melting of ice and snow.</p> <p>Observation of snow crystals or other crystals grown by the class as a home assignment.</p> <p>Experiment to show steam from boiling water and condensation on a cold surface.</p> <p>Experiment to show evaporation of water.</p> <p>Formation of dew.</p> <p>Recall frosting of window and appearance of hoar (white) frost to illustrate sublimation.</p> <p>Experiment to show sublimation with benzoic acid.</p>

Importance of water as a solid. (One period.)	Value of snow as a protecting cover for plants and as a means of water storage in nature. Experiment to show expansion of water on freezing, as a home assignment: application to floating of ice and to disintegration of rocks and formation of soil.
Importance of water as a gas. (Two periods.)	Experiment to show presence of water vapour in the atmosphere. Experiment to show great expansion of water on vaporization Reference to the steam engine.
Water as a solvent. (Three periods.)	Distilled and ordinary water: an experimental illustration of the separation of water and dissolved solids by distillation. Solution: experimental illustration of the relative solubility of solids: saturated solutions. The dissolving of air in water and its significance to marine life.
Hard and soft water. (One period.)	The cause of hardness in water. An experimental illustration of the behaviour of hard water with soap.
Thermometers. (Three periods.)	Recall thermal expansion of matter in each of its three states. Experiment to show thermal expansion of liquids. Thermal expansion of liquids as a means of measuring change in temperature. Use of freezing point and boiling point of water as fixed points in establishing a thermometric scale. Compare Fahrenheit and Centigrade scales by reading temperatures in both scales. Compare alcohol and mercury thermometers. Clinical thermometer. Dairy or hot bed thermometer.
Practice in measurement with metric units. (Four periods.)	Experimental measurement of the area of a rectangular card and of the volume of a rectangular solid. Experimental measurement of the volume of a liquid. Measurement of the mass of a solid by use of a balance. Care of balance.

Density. (Two periods.)	<p>Meaning.</p> <p>Density of the solid used above.</p> <p>Experimental determination of density of water.</p> <p>Importance in nature of maximum density of water.</p> <p>Experimental demonstration of density of mercury.</p>
Farm water supply. (Two periods.)	<p>Source; protection from pollution.</p> <p>Purification of water by boiling; use of chloride of lime.</p>
Pressure in liquids. (Two periods.)	<p>Experiment to show that water exerts pressure.</p> <p>Experiment to show that the pressure varies with the depth.</p> <p>Experiment to show that the pressure is equal in all directions.</p> <p>Recognition that the weight of a body is a force and that the pressure is due to weight.</p>
The composition of water. (Three periods.)	<p>The analysis of water by electrolysis to show that it is composed of two gases identified as oxygen and hydrogen.</p>
The composition of air. (Four periods.)	<p>An experimental illustration of the rusting of iron in damp air; the properties and identity of the fraction of air removed and the fraction remaining.</p> <p>Experimental illustration that atmospheric oxygen is necessary for combustion.</p> <p>Experimental illustration of the production of carbon dioxide by:</p> <ul style="list-style-type: none"> (a) combustion of carbon in air, (b) respiration. <p>Demonstration of such properties of carbon dioxide as density, and effect upon a flame.</p>
Importance of air. (One period.)	<p>The atmosphere.</p> <p>Air in soil; increased by cultivation and under-drainage.</p> <p>The resistance of air to moving bodies.</p>
Air pressure. (Three periods.)	<p>Experiments to show that air occupies space and that air has weight.</p> <p>Experiment to show that air exerts pressure.</p> <p>Applications: self-filling fountain pen, common water-pump, siphon.</p>

Measurement of atmospheric pressure. (Three periods.)	Construction of the mercury barometer; how it works.
	Variation from day to day and from place to place.
	The height of a water barometer.
	Observation of the aneroid barometer with practice in taking readings.
	Its use to measure altitude shown by taking readings at different levels.
Compression and expansion of gases. (Two periods.)	Experimental demonstration of the compression and expansion of air.
	Elementary discussion of the relationship of volume and pressure.
	Compression of air in the bicycle or automobile tire, air-pump, air-gun, air tools, sand-blast.
Convection in liquids. (Two periods.)	Recall thermal expansion.
	Experiment to show convection currents in water.
	Hot-water heating system or the hot-water incubator.
Convection in gases. (Three periods.)	Demonstration to show convection in air.
	Hot-air heating system.
	Air movement in a heated room.
	Importance of ventilation.
	Draught in chimney.
	Air movement in refrigerator; ventilation in the incubator.
Effects of water in motion. (One period.)	Rain-wash and how combated on farm lands.
	River erosion.
	Wave erosion.
	Deposition of sediment.
Effects of air in motion. (Two periods.)	Sailing ships, windmills.
	Soil drifting; how checked.
	Sand dunes.
	Rainfall and wind.

The work of the
Meteorological
Service.
(Three periods.)

Isobars.

Relation of winds to isobars.

Weather maps.

High and low pressure areas with their winds and weather.

Breeds, incubation
and management of
chickens.
(Ten periods.)

Recognition of at least six breeds of chickens kept in the locality; characteristics of the class to which they belong; hatching of chicks in the school incubator; brooding and rearing of chicks; housing and management of chickens; care of eggs.

Spring and Early Summer

Structure and function
of the leaf.
(Nine periods.)

Examination of leaf epidermis, including stomata.

Examination of a cross-section of a leaf to show arrangement of the cells and cell structure.

Demonstration of iodine test for starch.

Experiment to show that starch is made in green leaves in the light and disappears in the dark.

Demonstration of the presence of starch in seeds and tubers, etc.

The use of an aquatic green plant to show the exhalation of oxygen in bright light; the need for carbon dioxide in the process, e.g., comparison of effect with (a) boiled water, (b) boiled water with carbon dioxide added.

Experiment to show transpiration in green plants.

The structure and
function of the stem.
(Four periods.)

Examination of a cross-section of oak or other tree trunk to discover pith, heartwood, sapwood, rays, cambium, outer and inner bark.

Examination of green twig to discover increase in thickness due to activity of cambium and in length due to primary growth.

Demonstration of the rise of water in stems.

Absorption by roots.
(Five periods.)

Demonstration of the presence of mineral salts in solution in soil water.

Observation of the development of root hairs in germinating seeds.

Demonstration of diffusion of a gas in air and of a dissolved salt in a liquid.

Simple experiments illustrating the absorption of water with salts in solution through membranes and the significance of this in absorption by roots.

Methods and practice of gardening.
(Five periods.) Planning and preparation of the school or home garden.
Preparation, care and uses of the hot bed and cold frame.
Methods of growing early vegetables such as potatoes, onions, rhubarb, lettuce, cabbage, tomatoes.
Methods of growing annual and perennial flowers.

REFERENCE BOOKS

The reference books listed for the course in general science should be used for the corresponding topics in agricultural science. The following are recommended for other topics:

Dairying, Farm and Factory. Dean. The Ryerson Press, Toronto.

Poultry Production. Lippincott and Card (Fifth Edition). Lea and Febiger, Philadelphia.

The Garden Guide. The General Publishing Company, Toronto.

Bulletins of the Ontario Department of Agriculture, Toronto, and the Dominion Department of Agriculture, Ottawa.